

Journal section: Clinical and Experimental Dentistry

doi:10.4317/jced.3.e382

Publication Types: Case Report

Combined surgical and prosthetic approach for rehabilitation of frontonasal defect using custom made titanium implant: a case report

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Received: 13/02/2011

Accepted: 12/03/2011

Prithviraj DR., Anish G, Sumit K, Pujari M, Garg P. Combined surgical and prosthetic approach for rehabilitation of frontonasal defect using custom made titanium implant: a case report. J Clin Exp Dent. 2011;3(Suppl1):e382-5.

<http://www.medicinaoral.com/odo/volumenes/v3iSuppl1/jcedv3iSuppl1p382.pdf>

Article Number: 50511

<http://www.medicinaoral.com/odo/indice.htm>

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Abstract

Cranial vault deformities as a sequelae to trauma may be as high as 70%. The basic indications for cranioplasty are improvement of disfigured aesthetics and to provide protection to the intra-cranial contents. The possibility of producing custom-made implants opened a new era in the reconstructive surgery of the craniofacial deformities. The outcome of craniofacial bone reconstruction is thought to be dependent on surgical skills, quality of adjacent soft tissues, size and location of the bone defect and choice of repair method. The use of autologous bone for craniofacial reconstruction may be restricted due to limited amounts of donor bone. Combined surgical and prosthetic rehabilitation of these structures utilizing craniofacial implants is a viable option which offers several advantages when compared to surgical reconstructive techniques alone. Predictability and superior aesthetics are the major advantages of this technique. In addition to the advantages of good biocompatibility and mechanical strength, titanium also provides the advantage of being light in weight. This clinical report highlights the combined surgical and prosthetic approach for the successful management of frontonasal defect.

Key words: Craniofacial defect, frontonasal defect, alloplastic materials, custom made titanium implant, facial moulage

Introduction

Repair of craniofacial defects have long been a challenge to surgeons dealing with problems of reconstruction in which an effort is made to return the patient to some resemblance of normality(1). Surgical reconstruction of acquired or congenitally missing facial structures is a challenging task for maxillofacial surgeon because of inadequate soft tissue, cartilaginous or osseous support that exists. Combined surgical and prosthetic rehabilitation of these structures utilizing craniofacial implants is a viable option which offers several advantages when compared to surgical reconstructive techniques alone. Predictability and superior aesthetics are the major advantages of this technique. Titanium implant has been widely used in several surgical fields, such as craniofacial reconstruction and as orthopedic prosthesis. In addition to the advantages of good biocompatibility and mechanical strength; it also provides the advantage of being light in weight. This clinical report highlights the combined surgical and prosthetic approach for the successful management of frontonasal defect using custom-made titanium implant.

Clinical Report

Patient by name Balaraj came to the department of prosthodontics, Government Dental College and Research Institute, Bangalore, India on November 2009 with chief complaint of esthetic deformity in forehead region. Patient gave history of frontal and nasal bone fracture due to road traffic accident in the month of May, 2009. On examination mushroom shaped defect which measures about 6cm in width and 9cm in height involving frontal bone with nasal extension was detected. (Fig. 1) Irreversible hydrocolloid (Hydrogum, Zhermack, Badia polesine, Italy) impression material was used to make the impression of the face (facial moulage). Hydroco-



Fig. 1. Patient having frontonasal defect

loid impression was reinforced with a matrix of quick-setting plaster of Paris to prevent distortion of the impression. The reinforced impression was gently removed from the patient's face, and a working cast was poured with dental stone.

The contour of wax pattern was then determined by passing a sharpened pencil along the perimeter of the defect. Modeling wax (The Hindustan dental products, HDP, Hyderabad, India) was used to reconstruct the defective area to the desired dimensions on the working cast. Completed wax pattern was then placed over the defect on patient face to verify the contour. Wax try-in was carried out by using silicone adhesive material. Multiple holes of 2.5 mm diameter were made over the entire wax pattern at a distance of 2.5 mm to 3 mm from each other. The perforation in the custom made implant is a definite advantage since they allow accumulated fluid to seep out into the sub-galeal space, permit adhesions between the prosthesis and the soft tissue which helps to secure the former and allows adequate blood supply to the overlying flap i.e scalp.(1) Finished wax pattern was casted with titanium. Customized titanium implant was sterilized by steam autoclave.



Fig. 2. Reflected scalp tissues ensured adequate exposure of the defect.

Surgical procedure was carried out in the department of plastic surgery at Victoria hospital, Bangalore in the month January 2010 under general anesthesia. Bicoronal incision was given to expose the surgical defect. Scalp tissues were reflected to ensure good vascular supply and adequate exposure of the defect (Fig. 2). Fabricated prosthesis was then checked for proper adaptation to the bony margin and its over-all conformity with the face. Minor corrections of the prosthesis were done with the help of lab micromotor under sterile conditions. Screw holes were placed under copious saline irrigation to receive the screws. The customized titanium implant was stabilized in position with titanium screws at four points around its perimeter (Fig. 3). Haemostasis was achieved, suction drain was placed and closure was done by using silk suture material. Suture material was removed after ten days. Post operative recovery was uneventful. Es-

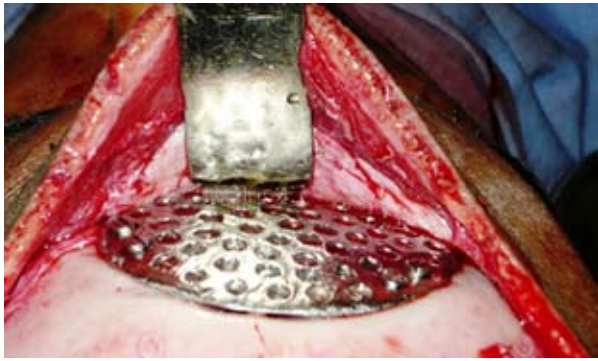


Fig. 3. Custom made titanium implant stabilized in position with screws.

thetics was restored to patient's expectations and he was happy when he came for follow up after seven months (Fig. 4).



Fig. 4. Rehabilitated frontonasal defect.

Discussion

The role of an implant within the body is to replace, augment, or in some manner assist the function of missing or inadequate tissue. Many materials have been used as implants for cranial defects, and their role in cranioplasty have been mainly to replace the missing bone part and improve esthetics of the affected area. Although autogenous bone grafts are the materials of choice for cranioplasties, acquisition of such bone grafts usually requires another incision and discomfort. At times it is difficult to shape the graft to conform to contour of the cranial

vault because of large defect size (2).

A variety of alloplastic materials are available for craniofacial reconstruction. The alloplastic materials which can be used for cranial rehabilitation include vitallium, tantalum, stainless steel and noble metal like silver. However, these materials are less biocompatible, show corrosion susceptibility (3). These metals also have a problem of high thermal conductivity and produces significant scattering in CT and MRI (4,5). The most popular alloplastic materials used in rehabilitation are titanium and methyl methacrylate (3). Polymethyl-methacrylate (PMMA) has been extensively used for cranioplasty. There is a tendency to shatter to impact, especially in large defects. Moreover the radiolucency of acrylic implant is a disadvantage to radiographic analysis in which fractures cannot be located by radiographs. A complication rate of $2\pm 12\%$ within the first 2 years is reported in the literature. (6)

Hence in this patient titanium was chosen as reconstruction material for frontonasal defect. The advantage of using titanium is its modulus of elasticity (15 psi x 106) which is close to bone (2.4 psi x 106) that leads to the even distribution of stress at the bone implant interface (7) It has favorable biocompatible property and MRI compatibility. It also produces minimal artifact in imaging. It has higher strength, low thermal conductivity and is lighter in weight (8,9) However the high cost of titanium and difficult in casting are the limiting factors. Casting titanium requires the use of a special vacuum furnace to ensure that the molten metal doesn't react with the atmosphere. Eufinger and Wehmoller used customized titanium implants to restore major cranial defects to achieve good aesthetic results. (10) He reconstructed an extreme frontal and frontonasal defect by microvascular tissue transfer and a prefabricated titanium implant. (11) In the present case report, rehabilitation of frontonasal defect was done by combined surgical and prosthetic approach, as use of autografts is preferred only for repair of defects which were less than 5cm in diameter. The perforation in the plate is a definite advantage since they allow accumulated fluid to seep out into the subgaleal space, permit adhesions between the prosthesis and the soft tissue which helps to secure the former and allows adequate blood supply to the overlying flap i.e. scalp. The highly polished surface makes it well acceptable and is well tolerated. In the present case titanium implant has served the basic goal of rehabilitation of the frontonasal defect.

Summary

Prosthodontists can play important roles in the team effort to repair craniofacial defects. Through their prosthetic capabilities, they can construct implants which provide adequate strength, form and esthetics to satisfactorily rehabilitate a variety of craniofacial defects re-

sulting from trauma or previous surgical treatment.

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